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The Influence of Environmental Factors upon the Genesis and Spread of Leptospirosis. by K. M. S'afarov

Veterinaria, USSR. 8: 33-36: 1955.

In the literature there is not a single opinion concerning the influence of environmental factors upon the genesis, spread and course of leptospirosis in domestic animals.

K. P. Andreev indicates that, "in the areas of propagation of leptospirosis, the character of the soil, plant life, temperatural conditions, humidity, amount of rainfall, barometric pressure and other climatic factors are so diverse that it is impossible to speak about the role of these factors in the appearance and spread of the disease."

M. V. Zemskov (1949) almost completely agrees with Andreev's opinion.

S. Ya. Liubachenko and V. S. Gazarian point out the large role of the soil-climatic factors in the spread of leptospirosis.

Our observations, made over a period of 14 years in the Azerbaijan SSR, enable us to add to this material.

We carried out our investigation, concerning the influence of soil-climatic and meteorological factors upon the genesis and outbreak of leptospirosis in animals in 5 different climatic oblasts with three different types of soil.

The Central Steppe Oblast. This oblast has 33 large cattle-raising rayons. In addition, from October to May, cattle are driven here from the mountain zone and from other republics.

By area size, particularly by the amount of pasture land, this oblast comprises almost half of the entire territory of the republic. Regardless, however, of the large concentration of animals in it during the fall, winter and spring periods, and the presence of points that are affected by leptospirosis, the disease here for the 14 years comprises only 16.4 % of the general number of outbreaks for the republic. In 70-80 % of the cases the animals are infected by leptospirosis during the fall when they are transferred from the mountain zone, and the disease begins in the low-lying zondin the first days of the cattle's arrival here.

The entire winter pasture area is located in the central climatic district. The district lies 17 m, and in certain places, 23 m below sea level. Only individual, comparatively small areas rise above sea level, and these rise no higher than 700 m. The following climatic data were characteristic for the entire oblast: an average annual temperature of 12-15° and higher; a degree of continentality equalling 44-59; 5 hot months. The lowest average monthly temperature occurs in January and the highest in July and August. The amount of rainfall on an average amounts to 300-400 mm. There are more

than 6 arid months. Spring is the dampest season of the year. It snows infrequently and the snow quickly melts. There are frequent winds with a 2 to 5-6 ball strength.

As is evident from the foregoing, the low-lying zone, where all the sheep livestock and a significant portion of the large livestock are situated, is distinguished by dryness of climate, and during the summer it changes to a burning semi-desert.

The Second Climatic Oblast of the Great Caucasus unites by its vertical zonality many climatic regions. There is a moderate-warm climate in the lowlands, in the foothills and in the lower zone of the Great Caucasian Forest. Here the average annual temperature is 10-12°; the average annual amplitude is 22-24°; the amount of atmospheric precipitation - 600 mm; there are few arid months; the maximum rainfall occurs in the summer period.

There is a moderate-cold, forest climate in the semi-mountain and mountain-forest zones of this district. The average annual temperature is 8°. Rainfall is 800 mm.

Above the timber zone, in the territory of the subalpine and alpine belts, there is a cold mountain climate. The average annual temperature is 4-6°. The winter is prolonged. Snow falls in September and remains on the mountains until June. The amount of atmospheric precipitation is 800 mm. and more. There are 16 rayons in the oblast.

For the 14 year period, 17.2 % of the general number of outbreaks of leptospirosis in the republic was registered in this oblast.

Of the indicated number of outbreaks, 93.6 % was observed in the foothill zone and in the lower zone of the Great Caucasian Forest with the moderate climate. There were practically no sicknesses in the second and third zones with the moderate-cold and cold climate.

In the Third Climatic Oblast of the Minor Caucasus the climate is distinguished by a greater dryness than in the second. According to climate the district may be divided into three zones: the upper alpine, the median alpine and the foothill, or lower zone. The average annual temperature is 4-13°; the summer lasts from 3 to 6 months; rainfall for a year is 500-600mm; height above sea-level is 400-900 m. The area of this oblast comprises approximately one-fifth of the republic's territory.

During the 14 years, 22 % of all outbreaks among the cattle in the republic occurred in this climatic oblast; of these, 65.4 % falls into the first and second zone.

The Territory of the Fourth Climatic Oblast may be broken into three sharply differing zones: the high-mountain alpine and mountain-forest, the low-lying, and the foothill zones.

In climatic relationship the high-mountain alpine zone resembles the second and third Oblasts with the only difference being: the climate of this

district is dryer. The climate of the low-lands and foothills of the fourth climatic district is distinguished by its mildness. Here the average annual temperature is 15° . There are 3-4 hot months. The winter is warm and without snow. There is a particularly humid climate in the low-lying zone. Here the rainfall for a year attains 500-1300 mm.

For the 14 year period in the given oblast was registered 8.9 % of the general number of leptospirosis sicknesses for the republic, whereupon 9.3 % occurred in the low-lying zone, 20.3 % in the foothill zone and 70.4 % of the outbreaks in the mountain zone.

The Fifth Climatic Oblast in a geographical sense is divided into two parts: the watershed in the region of the middle reaches of the Araks river, which occupies the south-western zone of the lower portion, and the folding, mountain zone of the Minor Caucasus with a mountain ridge up to 3900 m in height.

For the lower zone (the Araks river valley) an insignificant quantity of average annual rainfall, up to 300 mm, and a comparatively warm climate are characteristic. The average annual temperature reaches $11-12^{\circ}$. The winter lasts no longer than 3 months. At a height of 1200-1800 m there is noted a gradual increase in the quantity of annual precipitation, which attains 600 mm, and a lowering of the mean annual temperature to 7° . On the high mountains the quantity of rainfall reaches 800 mm with an annual temperature of $4-5^{\circ}$.

From the cited material it is plain that leptospirosis of animals is registered mainly in the oblast's mountain zone, where 91.7 % of its outbreaks occur.

An explanation of this is found in the fact that the mountain zone in the spring, summer and partially in the fall, is distinguished by its moderate climate. The burning heat does not occur here, intensive drying of pastures and the small, non-flowing, rain fed water-holes does not take place; there is no strong warming of the surface layer of soil and small water-holes that create a favorable medium for the propagation of leptospirae.

In addition to the climatic and meteorological factors, the structure of the soil exerts a great influence on the spread of leptospirosis in the mountain zone.

In the mountain zone the mountain-meadow, black-earth and podzolic soils are predominant. The majority of these soils are weak and are frequently situated on the surface of cliffs and outcrops of rock. Their humus content is from 15 to 18 %. In the majority of cases these soils have a neutral or weakly alkaline reaction ($\text{pH} = 7.0-7.4$), in the shaded areas they are acid ($\text{pH} = 6.0-5.0$) and less frequently weakly acid. The carbonate content, in comparison with the soils of the low-lying zone, is low or completely lacking; there is no salinity. The soil possesses good physical properties.

It is plain from what has been described that the soil in the mountain zone, particularly in its mountain-meadow portion, is suitable for the accum-

ulation and retention of moisture and for the propagation of leptospirae in the small, rain-fed watering places, and in the moist, swampy pastures.

In second place, according to the spread of leptospirosis, is the foothill zone. Transferring from the mountain zone to the foothill zone, the soil changes color from dark chestnut to chestnut brown, and then to light chestnut. As a result of a lesser quantity of rainfall, in comparison with the mountain zone, the content of carbonates in the upper layers of soil is higher, whereupon their number increases still more in the deep soil layers.

In connection with the decrease in rainfall, the amount of vegetation decreases; the humus content, which does not exceed 5 % here, correspondingly decreases. The soil has an alkaline reaction, contains no salinity and possesses good physical properties. In comparison to the mountain zone there is less moisture, and drying of the small watering places and pastures takes place more rapidly; this also serves as a reason for a lesser spread of the sicknesses in this zone.

In the republic's low-lying zone the climatic and meteorological conditions and soil structure are not conducive to the development of leptospirosis.

The soil of the low-lying zone consists of sierozem (gray desert soil - Tr. Note), a hard packed soil, brownish gray, brown, chestnut and other soil varieties. Salt marshes and saline soils make up the characteristic features of the zone.

The soil forming processes take place under the conditions of a high temperature and few atmospheric precipitations, therefore there occurs here an intensified mineralization of the rocks. The products of the erosion, because of insufficient atmospheric precipitations, are accumulated in the upper soil layers and form the salt marshes.

Chloride and sulfate marshes harmful to vegetation and soil microflora are encountered.

The soils of this zone are distinguished by a high content of carbonates in some portions (as high as 30-35 %). There is a direct relationship between the carbonate content and the temperature of the environment. With a drop of temperature the carbonate content also is lowered. The soils of this zone show an alkaline reaction; their pH ranges from 7.2 to 8.2. The alkalinity is explained by the presence of a bicarbonate of alkaline-ash metals in the soil solution.

The humus content in these soils ranges from 1 to 2 %. In view of this they possess highly unfavorable physical and, as a result of this, chemico-biological properties.

Based on the presented materials, one could consider that in the low-lying zone of Azerbaijan, leptospirosis does not find wide transmission basically for the following reasons:

1. In the low-lying zone, in the summer time, there are practically no permanent, stagnant water-holes, and the water-holes and swamps that form in the winter period quickly dry up in the summer; flowing water sources are used for irrigation of cotton and other cultivated areas.

2. Atmospheric precipitations fall in insignificant number and are quickly evaporated.

3. The soil of the low-lying zone is highly carbonate and saline. This often inhibits the propagation of leptospirae, even in the water sources. Our experiments also confirm the latter circumstance; when we were unable to raise leptospirae in a water mixture which was prepared from carbonate and saline soils; in a water mixture prepared from mountain-meadow soil the leptospirae multiplied well.

One should note that in the mountain and foothill zones of the republic, leptospirosis takes a more malignant course and gives a larger percentage of cattle plague. This circumstance "is not related to the serotype that is active here," as Zemskov considers it, but is explained precisely by the fact that in the mountain zone, there is a more massive reservoir of infection than in the low-lying zone.

In this manner, on the basis of the cited materials, we came to the conclusion that in the genesis, spread and course of leptospirosis, the leading role is played by the conditions of the environment and chiefly by climatic, meteorological and soil factors.